

THE EFFECT OF ADVERSARY UNMANNED AERIAL SYSTEMS ON THE US CONCEPT OF AIR SUPERIORITY

A Monograph

by

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ABSTRACT

THE EFFECT OF ADVERSARY UNMANNED AERIAL SYSTEMS ON THE US CONCEPT OF AIR SUPERIORITY, by Lt Col Jason W. Earley, 50 pages.

The last time an enemy aircraft attacked a member of the American ground forces was more than sixty years ago. Do adversary drones challenge this immunity? The widespread use of unmanned aerial systems (UAS), or drones, by both nation states and non-state actors warrants analysis of their impact on the concept of US air superiority. The potential to deliver nuclear, biological, chemical, or conventional weapons with a UAS constitutes a significant, multi-faceted threat.

This monograph proposes a framework for studying air control and leverages a case study of German V-weapons in WWII to research the following primary question: how do adversary unmanned aerial systems affect the US concept of air superiority? The hypothesis is that adversary UAS could prohibitively interfere with the concept of US air superiority and with US air, sea, and land operations. Two primary research findings support this hypothesis. First, the United States is currently vulnerable to small, inexpensive adversary drones. Second, the US concept of air superiority is a deeply rooted belief that sustained, theater-wide, joint, and primarily offensive operations can preclude enemy attacks from the air. These findings leave the United States with two primary courses of action. The United States can either change its concept of air superiority or commit the necessary resources to ensure continued immunity from aerial attack.

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Acronyms

AFDA 3-01	Air Force Doctrine Annex 3-01
C-UAS CONOPS	Counter-Unmanned Aircraft System Concept of Operations
CAS	Close Air Support
DCA	Defensive Counter Air
NATO	North Atlantic Treaty Organization
NTC	National Training Center
OCA	Offensive Counter Air
JFC	Joint Force Commander
JP	Joint Publication
JIPTL	Joint Integrated Prioritized Target List
RPA	Remotely Piloted Aircraft
UAS	Unmanned Aerial System
WWII	World War II

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Introduction

American ground forces assume they will be able to operate with minimal threat of attack from enemy aircraft or missile systems. For nearly six decades, Air Force investments, expertise, and sacrifice in achieving air superiority have ensured that condition.¹

—United States Air Force Posture Statement 2012

On April 15, 1953, an enemy aircraft attacked and killed two US Army Soldiers in Korea. The enemy aircraft, named the PO-2, was a single engine, fabric-covered biplane designed by the Soviet Union in the 1920s. This attack was significant for two critical reasons. First, the attack occurred more than six decades ago. The PO-2 attack was the last time an enemy aircraft engaged US military forces operating on the ground. US forces are enjoying sixty years of immunity from air attack. Second, a slow, light, and highly maneuverable aircraft conducted the attack. Ironically, the PO-2's three-decade-old technology made it too evasive for air superiority assets of the time.² The sweeping proliferation of unmanned aerial systems (UAS) brings this historical event to the forefront of US planning. Is sustained US air superiority in question? Are UAS capable of eluding modern day air superiority assets like the PO-2 did in 1953? Are US ground forces in danger of attack from the air?

As the epigraph above indicates, US military personnel assume air superiority when they take the battlefield. The skies belonged to the United States and its allies during the recent conflicts in the Middle East. Initial air wars lasted only a few days and quickly achieved air superiority. Airpower assets then focused on air interdiction and close air support. Friendly ground forces are accustomed to this type of operating environment. When an American Soldier begins an attack, his or her focus is straight ahead, at ground level, searching for a two-

¹ United States Air Force Posture Statement (Washington, DC: Government Printing Office, 2012), 14.

² Peter Grier, "April 15, 1953," *Air Force Magazine*, June 2011, accessed July 10, 2014, <http://www.airforce-magazine.com/MagazineArchive/Pages/2011/June%202011/0611april.aspx>.

dimensional enemy. For adversary fighters, this is simply not the case. The enemy must always consider the three-dimensional threat. This advantage is paramount to US national security.

The widespread use of unmanned aerial systems, or drones, by both nation states and non-state actors warrants analysis of their potential impact on the US concept of air superiority. Politically, psychologically, and operationally, air superiority is important. UAS are capable of attack, reconnaissance, and a variety of other tasks. The potential to deliver nuclear, biological, chemical, or conventional weapons with a UAS constitutes a significant threat. What does air superiority *mean* in the face of adversary capacity to employ UAS? Unmanned aerial systems pose a significant threat that may challenge US air superiority.

Based on these considerations, this monograph researches the following primary question: how do adversary unmanned aerial systems affect the US concept of air superiority? The hypothesis is that adversary UAS, as an emerging threat, pose a unique challenge to the US concept of air superiority. Adversary drones have the potential to be a sporadic but deadly and psychologically powerful weapon that prohibitively interferes with the current concept of US air superiority and with US air, sea, and land operations.

This paper follows a four-step methodology to test this hypothesis. The first step is to establish a working understanding of the *US concept of air superiority*. This thesis is as much about air control as it is about UAS. Air superiority is the degree of air control that permits operations without prohibitive interference by adversary threats.³ However, the US concept of air superiority conveys additional perceptions and assumptions that require further examination.

The second step is to propose a theoretical framework for studying how specific threats affect air superiority. The theory establishes a relationship between three variables: the desired level of friendly air control, the intensity of the enemy threat, and the amount of friendly effort.

³ Joint Publication (JP) 1-02, *Dictionary of Military and Associated Terms* (Washington, DC: Government Printing Office, 2010 (Amended through 2013)), 11.

For example, given a significant enemy threat, even limited friendly effort may still be able to achieve at least local air parity. Conversely, if seeking theater-wide air superiority, tremendous friendly effort may be required against even the smallest threats.

The third step is to apply the theoretical framework to an historical case study—German use of V-weapons in World War II (WWII). The German V1 and V2 challenged the concept of Allied air superiority during WWII. The history surrounding the V-weapons parallels the current challenge to air superiority by adversary UAS. What threat did the German V-weapons pose? What was the Allied friendly effort in response? What level of air control did the Allies decide was necessary to protect British citizens? The answers to these questions provide an historical example that frames potential modern day solutions.

Finally, the fourth step is to apply the theoretical framework to adversary UAS in light of the conclusions drawn in the first three steps. Additionally, the stated theoretical framework helps enable future US decision making. As the level of threat grows beyond that depicted herein, US planners can apply the framework to help determine the friendly effort required to achieve the desired level of air control.

Before proceeding, it is important to explain the use of the term unmanned aerial systems to describe the adversary threat. The terminology used to describe airborne drones changed numerous times over the last decade. The US Air Force recently returned to describing these assets as Remotely Piloted Aircraft (RPA) instead of unmanned aerial systems. The primary reason for this change is the underlying message the two terms convey. Whereas unmanned indicates a lack of human involvement, remotely piloted stresses the importance of the operator to the aircraft. This monograph uses the term unmanned aerial system to delineate between US and adversary drones and to stress the importance of considering the entire adversary drone system. To aid in readability, the term adversary drone replaces UAS numerous times in this monograph. In this discussion, the two are equivalent terms.

The Concept of US Air Superiority

Air superiority has a very specific definition in US joint doctrine. However, like many other military terms, the concept of air superiority goes far beyond what a two-sentence description can convey. In order to understand the US concept of air superiority, several items require examination. First, it is critical to understand the importance of air superiority. Second, studying the history and theory behind air superiority provides a solid foundation. Third, from that foundation, an exploration of US air superiority doctrine is possible. Ultimately, these elements enable an understanding of air superiority's impact on US military operations.

The Importance of Air Superiority

During a WWII-era speech concerning the ongoing struggle for air superiority over the United Kingdom—dubbed “the Battle of Britain”—Sir Winston Churchill famously stated:

We believe that we shall be able to continue the air struggle indefinitely and as long as the enemy pleases, and the longer it continues the more rapid will be our approach, first towards that *parity*, and then into that *superiority* in the air, upon which in a large measure the *decision of the war depends*. The gratitude of every home in our Island...goes out to the British Airmen who, undaunted by odds, unwearied in their constant challenge and mortal danger, *are turning the tide of the world war*...Never in the field of human conflict was so much owed by so many to so few. [emphasis added]⁴

Prime Minister Churchill's words capture important elements of the concept of air superiority. He mentioned the transition from parity to superiority, stated that WWII depended on the Battle of Britain's outcome, and claimed undaunted British Airmen are turning the tide of the war.

Churchill believed air superiority was critical. A battlefield commander on the opposite side of the conflict echoed the sentiment of Britain's political leader. German Field Marshall Erwin Rommel believed, “Anyone who has to fight, even with the most modern weapons, against an enemy in complete control of the air, fights like a savage against a modern European army.”⁵ It is

⁴ Winston Churchill, “The few” (speech, House of Commons, London, August 20, 1940).

⁵ John Warden III, *The Air Campaign* (New York: toExcel Press, 2000), 11.

important to note these leaders are not airpower enthusiasts pushing their own agendas. Instead, a famous politician and a prominent land warrior recognized the importance air superiority played in their endeavors. These two leaders represent just a sample of the widespread belief in the decisive importance of air superiority. Their claims find support in theory, history, and doctrine.

Air Superiority Theory

The theory behind air superiority covers a wide range of considerations. Central to this research and the US concept of air superiority are two main contrasts: *offense versus defense* and *local versus theater*. Airpower theory began taking shape in the early twentieth century thoughts and writings of Italian General Giulio Douhet. Concurrently, American General William “Billy” Mitchell wrote his airpower thesis titled *Winged Defense*. More recently, US Air Force Colonel John Warden III wrote *The Air Campaign* and designed a large portion of the coalition air strategy in Operation Desert Storm. Combining the ideas of these three theorists and tying them to historical examples shows that attaining air superiority through offensive action is usually better than establishing a defense. Additionally, the theorists show the value of sustained theater versus temporary local air superiority. The concepts of offense versus defense and sustained versus temporary directly affect US decisions on air control given the adversary UAS threat.

Carl von Clausewitz noted that in land warfare, the defense is often stronger than the offense.⁶ However, Colonel Warden contends the opposite is true in air battle for several reasons. First, the speed of aircraft makes it difficult to mass defenses against them. Second, due to the fluidity of airpower, an immense number of attack axes are possible. Finally, when fighters meet in the air, the lines between offense and defense are temporarily blurred.⁷ Unlike the infantryman who benefits from the shelter of his foxhole, during an air engagement the defender does not have

⁶ Clausewitz, Carl Von, *On War*, ed. and trans. Michael Howard and Peter Paret (New Jersey: Princeton University Press, 1976), 357.

⁷ Warden, 57.

any inherent protection. In fact, time is not on the defender's side. He or she must quickly dispense with the current threat so that another adversary does not simply pass by during the engagement. In summary, in order to defend in the air you have to be strong everywhere; in order to conduct an air offensive, you only have to be strong for a short time at a specific place. In general, adversary UAS operations seek to challenge US air superiority through offensive means.

Douhet and Mitchell also theorized on the offense versus defense argument. From the title of his thesis, it would appear Mitchell supports the defense—nothing could be farther from the truth. In fact, he believed, “The only defense against aircraft is by hitting the enemy first, just as far away from home as possible.”⁸ Douhet agreed, “The very magnitude of possible aerial offensives cries for an answer to the question, ‘How can we defend ourselves against them?’ To this I have always answered, ‘By attacking.’”⁹ These attacks include not only meeting enemy fighters in the air, but also effecting their destruction on the ground. From the outset, airpower theory stressed the importance of a highly offensive approach to gaining air superiority. The US understanding of airpower resonates from this concept.

The second important aspect of air superiority theory is the contrast between local and theater-wide control of the air—both have their pluses and minuses. The main advantage of local air superiority is the comparatively lower amount of effort required to attain it. An air force on the offense can surge assets to temporarily overwhelm adversary defenses. However, once the surge of assets culminates, control of the air returns to the defender. On the other hand, theater-wide control of the air has almost opposite advantages and disadvantages. The effort required to attain *and* sustain control of the air is significantly higher. This endeavor often requires a large commitment of time and combat resources. Nonetheless, the reward is equally more beneficial.

⁸ William Mitchell, *Winged Defense* (New York: G.P. Putnam & Sons, 1925), 213.

⁹ Giulio Douhet, *Command of the Air* (Washington DC: United States Air Force Warrior Studies, Originally printed in book form in 1921), 52.

The combatant with air superiority now gains the advantages referenced by Sir Winston Churchill and Field Marshall Rommel. Colonel Warden neatly sums up the contrast between local and theater air superiority: “Winning air superiority is difficult and one of the surest ways to fail is to think you can take the parsimonious approach and just go for local superiority. Local air superiority is a very dangerous idea simply because it ends up requiring air defense, which is very difficult.”¹⁰ Theater-wide sustained air superiority is a loftier, more difficult goal. This type of control of the air is pervasive in the US concept of air superiority. Moreover, the concept applies directly to decisions regarding German V-weapons and adversary UAS. These decisions are not only theoretical; they exist in many historical examples.

Air Superiority History

Two historical situations illustrate the US concept of air superiority: Allied operations in the Pacific during WWII and the 1973 Yom Kippur War in the Middle East. Achieving air superiority in the Pacific Theater was both a joint endeavor and a joint goal, but, General Douglas MacArthur faced a challenging conundrum. It was difficult to attain air superiority without land-based aircraft and it was impossible to employ land-based aircraft without secure airstrips for their operation. This lack of secure airstrips limited MacArthur’s ability to strategically bomb Japanese holdings. In fact, Warden contends, “MacArthur used his ground forces primarily to seize bases from which air forces could extend the bomb line.”¹¹ The United States employed a combined arms strategy to seize these island airstrips. One example is the fight for Guadalcanal. The primary objective of this costly campaign was the establishment of Henderson airfield.¹² The ability to operate land-based aircraft from Henderson was the key to follow-on control of the

¹⁰ Warden, 159.

¹¹ Ibid., 26.

¹² Joe Gray Taylor, “Air Superiority in the Southwest Pacific,” in *Case Studies in the Achievement of Air Superiority*, ed. Benjamin Cooling (Washington DC: Center for Air Force History, 1994), 332.

Solomon Islands—the next step in the Allied Pacific strategy.¹³ Fighters and bombers (launched from aircraft carriers), long-range bombers, Marines, and Army Soldiers all worked together to seize the island. They extended the reach of Allied air power while limiting that of the Japanese. Air superiority was a joint goal that required joint action to achieve. This remains true for US air superiority in the face of the adversary drone threat.

Although the United States was not directly involved, the Yom Kippur War provides two key insights on the US concept of air superiority. First, Israel had tremendous success in the air during a previous conflict in 1967 and felt confident it could quickly achieve air superiority again. Israel believed Egyptian and Syrian surface-to-air missiles would provide only a minor threat it could quickly overcome. Both of these assumptions proved wrong. Colonel Warden believes these errors in judgment resulted from an air of overconfidence.¹⁴ In 2014, after sixty-one years of air superiority, the United States should be wary of similar complacency given the UAS threat.

The second insight from 1973 ties back to the theoretical contrast between offense versus defense and strengthens the idea that air superiority is a joint endeavor. In 1967, Israel took a very offensive stance in achieving air superiority. However, in 1973, political considerations prevented Israel from acting as the aggressor. This precluded preemptive attacks against enemy air superiority assets and placed Israel on the defense.¹⁵ As a result, Israel was unable to achieve air superiority solely with its air force and the process took significantly longer than in 1967.¹⁶ The air superiority tide finally turned in Israel's favor when then Major General (and later Israeli Prime Minister) Ariel Sharon crossed the Suez Canal with a ground force and destroyed

¹³ Taylor, 332.

¹⁴ Warden, 29-30.

¹⁵ Brereton Greenhous, "The Israeli Experience," in *Case Studies in the Achievement of Air Superiority*, ed. Benjamin Cooling (Washington DC: Center for Air Force history, 1994), 588.

¹⁶ *Ibid.*, 595.

numerous Egyptian surface-to-air missiles.¹⁷ His ground attack opened an aerial gap for the Israeli Air Force to exploit. The Yom Kippur war highlights both the importance of offensive operations and the joint nature of air superiority. These concepts resonate in both the Allied response to the German V-weapons and the ability to thwart adversary UAS discussed below.

US Air Superiority Doctrine

History and theory provide an excellent framework for the development of doctrine. Different nations and different eras define air control terms differently. For example, Douhet wrote, “To have command of the air means to be in a position to prevent the enemy from flying while retaining the ability to fly oneself.”¹⁸ In the 1920’s this may have seemed like a reasonable definition for air superiority. However, the intervening years, technological advances, and practical integration of airpower onto the battlefield require a more nuanced approach. *US Air Force Doctrine Annex 3-01 Counterair Operations* (AFDA 3-01) specifies the US definition of air control as: “a level of influence in the air domain relative to that of an adversary, and is categorized as parity, superiority, or supremacy.”¹⁹ *US Department of Defense Joint Publication 1-02 Dictionary of Military and Associated Terms* (JP 1-02) and AFDA 3-01 define these terms:

air parity—A condition in the air battle in which one force does not have air superiority over others. This represents a situation in which both friendly and adversary land, maritime, and air operations may encounter significant interference by the opposing air force. Parity is not a “standoff,” nor does it mean aerial maneuver has halted. On the contrary, parity is typified by fleeting, intensely contested battles at critical points during an operation with maximum effort exerted between combatants in their attempt to achieve some level of favorable control.²⁰

¹⁷ Greenhous, 588.

¹⁸ Douhet, 24.

¹⁹ Air Force Doctrine Annex (AFDA) 3-01, *Counterair Operations* (Washington, DC: Government Printing Office, 2014), 3.

²⁰ *Ibid.*, 4.

air superiority — That degree of dominance in the air battle by one force that permits the conduct of its operations at a given time and place without *prohibitive interference* from air and missile threats. [emphasis added]²¹

air supremacy — That degree of air superiority wherein the opposing force is incapable of effective interference within the operational area using air and missile threats.²²

US doctrine further explains control of the air through use of a spectrum (Figure 1). At the center of the spectrum is air parity. When air parity exists, both combatants experience significant resistance to their operations. This resistance occurs in the air, sea, and land domains.

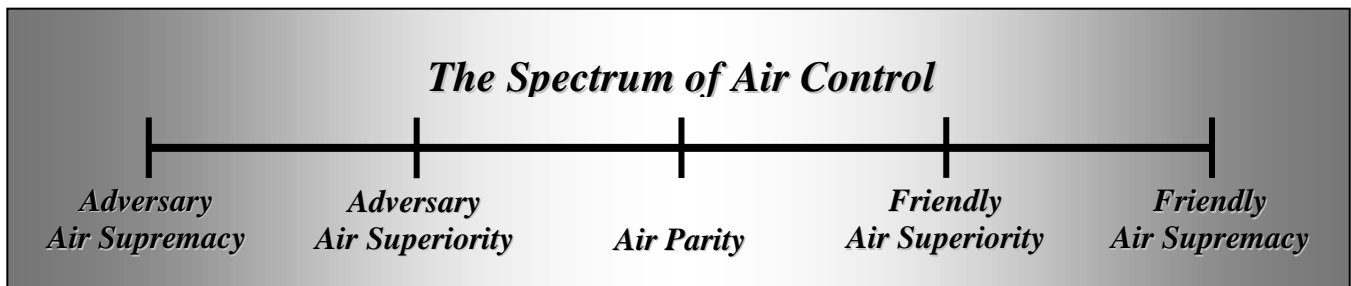


Figure 1. The Spectrum of Air Control

Source: Created by the author based on a similar diagram and concept in AFDA 3-01

The initial stages of the Battle of Britain provide an example of air parity. German aircraft were unable to attack, conduct reconnaissance, or employ other tasks without significant resistance. However, German aircraft successfully restricted Allied ground movements, interdicted sea operations, and killed civilians. Given air parity, air, sea, and land operations by both combatants face notable interference. Moving left or right on the spectrum, when one combatant achieves air superiority, it is able to conduct operations without “prohibitive interference.” While air superiority gives one side the ability to operate without prohibitive interference, moving to the outer edges of the spectrum and achieving air supremacy renders the opposite side incapable of conducting *any* effective interference. Stated another way, a combatant with air superiority should expect some interference; one with air supremacy, quickly counters any attempts at interference.

²¹ JP 1-02, 11.

²² Ibid.

Building from this baseline understanding of the spectrum, US doctrine goes on to empower the Joint Force Commander (JFC) to determine what level of air control he requires to accomplish the mission. Pervasive throughout *Joint Publication 3-01 Countering Air and Missile Threats* (JP 3-01) is the idea that the JFC determines a desired degree of air control that satisfies overall campaign objectives with minimal effort by friendly forces.²³ While air supremacy may be the most desirable, air superiority is often sufficient to achieve the JFC's desired effects.²⁴ Regardless, the JFC makes this determination and directs forces to achieve the desired control of the air. In WWII, Allied leaders faced this decision against the V-weapons threat. Similarly, today's JFCs must decide how many UAS incursions would constitute prohibitive interference.

Once the JFC makes this important determination, US joint forces employ two primary approaches in establishing the desired degree of air control: offensive counter air (OCA) and defensive counter air (DCA). Again, AFDA 3-01 provides insight:

The objective of OCA is to destroy, disrupt, or degrade enemy air capabilities by engaging them as close to their source as possible, ideally before they are launched against friendly forces. The objective of DCA is to protect friendly forces and vital interests from enemy airborne attacks and is synonymous with air defense.²⁵

OCA includes a wide range of tactics. Fighter aircraft like the F/A-18 Super Hornet or the F-22 Raptor carry out OCA when they directly engage enemy aircraft over enemy held territory. B-2 Spirit bombers conduct OCA when they attack enemy airfields or aircraft production facilities. Army ground maneuver elements execute OCA when they seize enemy airfields. OCA encompasses any offensive task aimed at preventing the adversary from flying.

DCA also spans numerous military actions. Fighter aircraft like the F-15C Eagle conduct DCA when they fly combat air patrols to defend friendly assets. Army Patriot missile batteries are

²³ Joint Publication (JP) 3-01, *Countering Air and Missile Threats* (Washington, DC: Government Printing Office, 2012), numerous pages.

²⁴ AFDA 3-01, 5.

²⁵ *Ibid.*, 6-7.

a critical node in the DCA fight when they act as an umbrella of friendly surface-to-air-missile protection. US Navy ships armed with the Aegis Ballistic Missile Defense System also support the DCA mission working in concert with Air Force and Army assets. Whether defending a specific point, a large area, or a high value asset, when US forces place themselves between the air threat and assets in need of protection, they are employing DCA.

Summary: The US Concept of Air Superiority

US air superiority is a multi-faceted concept rooted in history, theory, and doctrine. Churchill and Rommel help convey its importance. Warden, Douhet, and Mitchell stress the need to achieve sustained, theater-wide air superiority through mostly offensive actions. Guadalcanal and the 1973 Yom Kippur War provide historical examples showing air superiority is a joint endeavor. US doctrine depicts a spectrum of air control and establishes the JFC's role in determining the amount of air control required to achieve the objective. Combining all these aspects—and expectations from the last six decades—the US concept of air superiority entails comprehensive joint and predominately offensive operations to prevent prohibitive interference on US actions while providing sustained immunity for US personnel from enemy air attack. Air superiority empowers the United States to do what it wants—this paper will show that adversary UAS negatively impact this freedom of action.

Theoretical Framework

With an understanding of the US concept of air superiority in mind, the next step is to propose a theoretical framework for studying how specific threats affect air superiority. The air control spectrum depicted above (Figure 1) provides the canvas for this framework. The relationship between three variables—the desired level of friendly air control, the intensity of the enemy threat, and the amount of friendly effort—is in a constant state of give and take.

Desired Level of Friendly Air Control

The JFC must consider numerous factors to decide what level of air control meets mission requirements. One important consideration is the timeline of the operation. In short, temporary operations, air parity may be acceptable. For example, during a special operations mission aimed at inserting or extracting personnel, mission planners may not want to draw unneeded attention by conducting a full-scale air superiority effort. Instead, protecting rotary wing and air refueling assets at a specific time and place may be the best solution. Conversely, if the JFC desires to emplace a large conventional ground force for an extended deployment, a sustained level of air control approaching air supremacy may be more prudent.

In the broadest sense, the protection of US national interests should be the overall driving factor in the JFC's decision. During Operation Desert Storm, Iraq attempted to draw Israel into the conflict by attacking them with short range ballistic missiles known as SCUDs. The Rand Corporation reported, "The Scud attacks on Israel, it was feared, would provoke an Israeli military response that would make it difficult for Arab states to remain a part of the anti-Iraq coalition."²⁶ To prevent this, the United States struck a deal with Israel and employed Patriot missile batteries (an air control asset) to counter the SCUD threat aimed at Israel. This appealed both the Israeli leadership and protected its citizenry. Israel did not retaliate and Arab states remained with the anti-Iraq coalition. In this case, the JFC used air superiority resources to protect predominately non-US assets because it served the national interest.

The JFC's desired level of air control is the first of three variables in the theoretical framework. Japanese kamikaze attacks during WWII provide an historical example that helps clarify the use of the two remaining variables—intensity of enemy threat and friendly effort committed. As Japan found itself on the defensive, backpedalling in the Pacific Ocean towards its

²⁶ William Rosenau, "Special Operations Forces and Elusive Enemy Ground Targets: Lessons from Vietnam and the Persian Gulf War," Rand Corporation (2001): 29.

home islands, a new type of aerial attack emerged. Japanese pilots turned their fighter-sized aircraft into missiles and began conducting suicide attacks against American ships. They dove into American warships and caused significant damage, often sinking the vessel. They killed themselves and many Sailors on board their targets. The kamikaze attacks became so threatening to the US Navy that “even before the first American landings at Okinawa, the US Navy wanted Japanese aircraft to be smashed in their lairs...Admiral Spruance recommended to Admiral Nimitz ‘all available attacks with all available planes.’”²⁷ It is important to note that the Japanese began the kamikaze attacks because they could no longer effectively conduct more traditional air operations—the battle for control of the air was shifting in the United States’ favor. The quote above shows the drastic impact these attacks had on the US friendly effort and focus—Spruance and Nimitz wanted *all* available planes committed. However, even given this significant friendly effort, many kamikazes achieved success. Although US forces attacked forty-five Japanese air bases, fifty kamikaze and traditional bombers still succeeded in damaging three aircraft carriers.²⁸

In addition to the toll they took in lives and equipment, kamikaze attacks also had a psychological impact. Dr. Alvin D. Coox, a professor of history and Asian studies, penned:

For many who had survived every other kind of fantastic battle experience, [kamikaze] was the most bewildering and terrifying experience of the war. It was... ‘like being surrounded every minute of the day and night by a forest fire.’ Particularly unnerving was the fact that ‘there was no defense against [a kamikaze] pilot short of blowing him up in the air. The son of a bitch dives straight at you, and what are you going to do about it?’²⁹

Even given an enormous friendly effort, the intensity of the enemy kamikaze attacks still had an impact on the physical and psychological perception of air superiority. Although Spruance and Nimitz desired air supremacy, they were unable to achieve it: “In the battle against kamikazes, air supremacy had to be absolute; one operational Japanese pilot was as great a hazard in the autumn

²⁷ Alvin D. Coox, “War Against Japan,” in *Case Studies in the Achievement of Air Superiority*, ed. Benjamin Cooling (Washington DC: Center for Air Force History, 1994), 419.

²⁸ Ibid.

²⁹ Ibid.

of 1944 and the first two weeks of 1945 as ten, twenty, or perhaps even fifty planes had been in 1942 and 1943.”³⁰ Spruance and Nimitz desired a level of air control equal to air supremacy and the United States put forth a significant friendly effort. However, the type and intensity of the enemy threat effectively inhibited US operations. Figure 2 below depicts how the three variables affected the air control spectrum. The desired level of air control was air supremacy. The United States put forth a significant friendly effort. However, the intensity of the enemy threat restricted US efforts and resulted in a level of air control between air superiority and air parity.

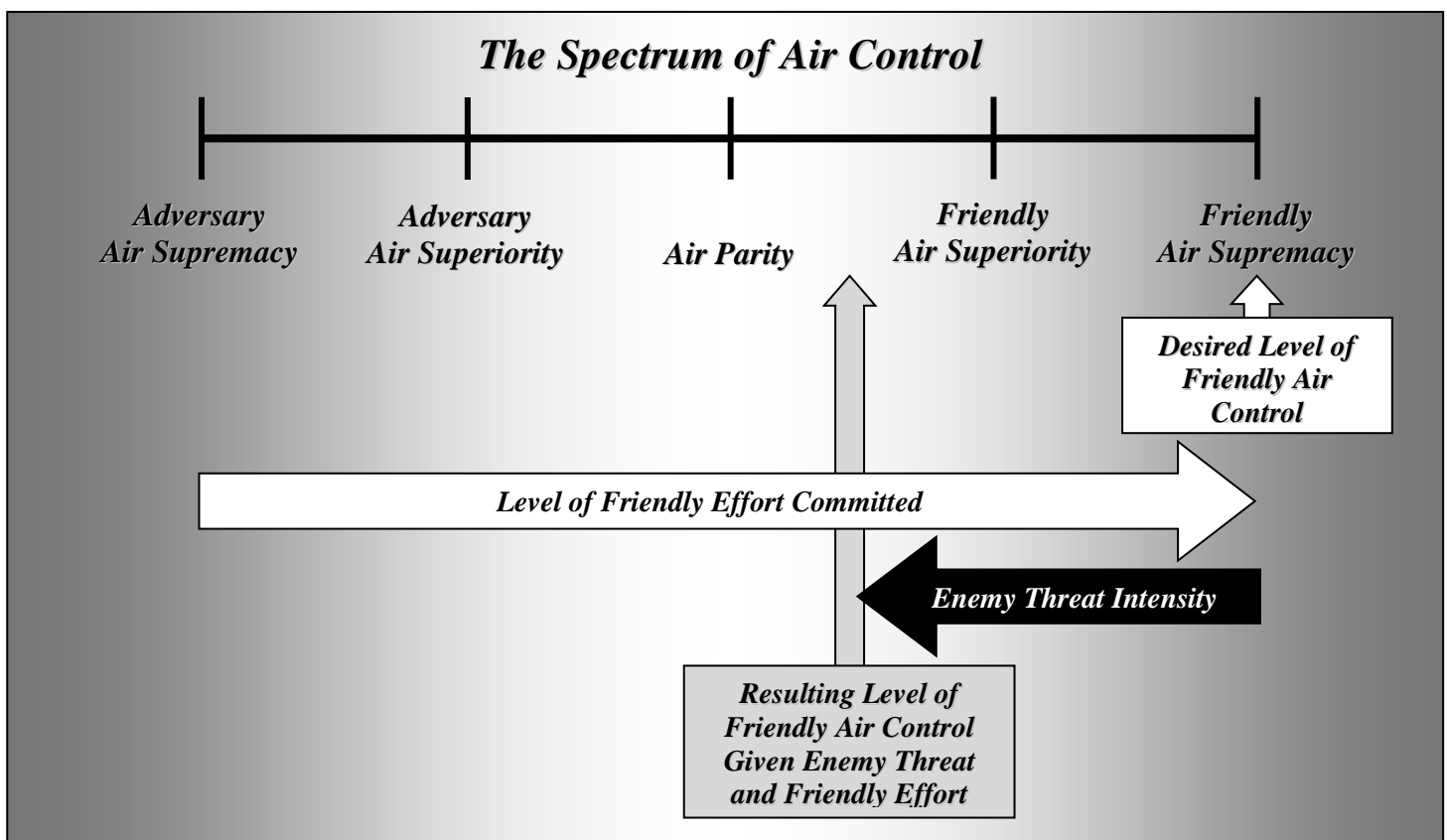


Figure 2. The Spectrum of Air Control—Kamikaze Attacks

Source: Created by the author based on a similar diagram and concept in AFDA 3-01

³⁰ Taylor, 370.

Intensity of the Enemy Threat

The kamikaze attacks used offensive tactics to challenge the desired level of friendly air control. The attacks sought to breach US defenses to achieve a purpose. This theoretical framework approaches the threat from the same perspective. German V-weapons had an offensive purpose. The adversary UAS investigated in this monograph conduct primarily offensive or intelligence tasks. Stated another way, the framework seeks to determine adversary offensive capability. Several factors help define the intensity of the enemy threat. How many and what type of weapons does the enemy have? What effects can they accomplish? Does the enemy possess the training and logistics needed to employ their resources? Finally, what objective is the adversary attempting to achieve—a spectacular destructive attack or a persistent intelligence campaign? The answers to these questions help define the intensity of the enemy threat.

Friendly Effort Committed

The US response to the kamikaze attacks provides insight into measuring the friendly effort. The United States employed both OCA and DCA to counter the kamikaze threat. They used bombing raids to destroy Japanese aircraft on the ground and as US forces gained territory from the Japanese, they rendered enemy airfields unusable. Both of these are examples of OCA. Conversely, they employed fighters to engage the kamikazes and anti-aircraft artillery in an attempt to umbrella the fleet—both examples of DCA. Finally, in order to make their OCA and DCA efforts successful, they gathered the best possible intelligence on enemy activities. These three actions—OCA, DCA, and intelligence operations—bound the friendly effort.

On November 10, 1932, three-time British Prime Minister Stanley Baldwin gave a speech to the House of Commons on disarmament. He coined these now famous words, “I think it is well also for the man in the street to realize that there is no power on earth that can protect him from

being bombed, whatever people may tell him. The bomber will always get through.”³¹ Baldwin’s words convey a prudent need to avoid complacency and plan for enemy aerial attacks. In that vein, this section described how the desired level of air control, the intensity of the threat, and the friendly effort vary with each other to result in a measurable position on the air control spectrum.

Historical Case Study German V-weapons and the Allied Response

The proposed theoretical framework addresses numerous important aspects of Germany’s use of V-weapons in World War II. The V1 and V2 represented a previously unseen threat to Allied air superiority. The Germans focused the weapons on Allied populations—thereby escalating their political and psychological impact. The framework applies well to the history surrounding the V-weapons. The Germans posed a significant threat. The Allies put forth a friendly effort in response. The result was a measurable level of air control during the campaign.

Intensity of the German V-weapon Threat: Adolf Hitler’s Motivation

Adolf Hitler had an infatuation with highly technical, revolutionary, and super-secret weapons. He pushed German scientists to develop advanced technology like jet engines and atomic weapons that still help define modern warfare. One of these secret endeavors was the V-weapons program. Although initially Hitler may have had a more glamorous inclination behind the weapons, as an Allied invasion of continental Europe seemed imminent, his motivation shifted to a strategic endeavor with a specific end-state.

Professor and military historian Sir John Keegan helps paint a picture of the V-weapons’ impact and the effects Hitler hoped to achieve:

The V-1 was a highly effective weapon, hated and rightly feared by Londoners and the residents of other British cities...its approach was signaled by its distinctive pulse-jet

³¹ Stanley Baldwin, “The bomber will always get through” (speech, House of Commons, London, November 10, 1932).

beat, the beginning of its descent by silence, its impact by a major explosion. Because of its low terminal speed, it caused destruction over a wide area and heavy loss of life.³²

The V-weapons evoked terror in the United Kingdom at the perfect time for Hitler. At the outset of the Normandy campaign, the *Luftwaffe* was unable to conduct any consistent attacks on the United Kingdom. Hitler needed a strategic tool that would continue to threaten the British citizenry. Basil Collier, a prolific British WWII historian and author, captures this thought succinctly, “In 1943 Hitler’s attitude to long-range weapons underwent marked changes, dictated largely by his increasing need of an answer to Allied bombing.”³³ Hitler and the German High Command hoped to begin a large-scale bombardment with both V-1 flying bombs and V-2 rockets in late 1943 or early 1944.³⁴ Hitler did not aim the V-weapons at a tactical element or an operational force. His intended targets were not limited to industrial centers or production facilities. He intended the V-weapons to strike the British people causing panic and inflicting pain. This intent served two clear purposes—a negative impact on British psyche and a positive impact on German morale. The V-weapons were a strategic asset used to achieve a specific strategic end state—an important fact to keep in mind when assessing adversary UAS endeavors.

Intensity of the German V-weapon Threat: Effects of the V-weapon Attacks

The German High Command gave orders to conduct the first V-weapon attacks in a seemingly immediate response to the Allied invasion at Normandy. The initial plan was to launch a coordinated night attack against London on June 12, 1944. The first attack did not go well. In fact, German troops fired only ten of a planned 500 V-1s. Of the ten weapons launched, five

³² John Keegan, *Intelligence in War* (New York: Vintage Books, 2002), 284.

³³ Basil Collier, *The Defense of the United Kingdom* (London: Her Majesty’s Stationery Office, 1957), 339-40.

³⁴ Ibid.

crashed just near the launch site, one was lost, and four reached England. Only one weapon caused casualties—killing six people and injuring nine in the town of Bethnal Green.³⁵

After the initial volley, German launch success improved dramatically and the number of attacks steadily rose. By July 1944, approximately 100 V-1 flying bombs reached Britain on a daily basis. Of these, roughly fifty passed through the defenses and impacted around greater London.³⁶ The first weapon that landed in the capitol carried a warhead believed to weigh 2000 pounds; it destroyed an East End railway bridge.³⁷ Overall, the Germans launched 10,492 V-1s. Of these, 2,419 reached Britain's defense ring; 1,112 broke through those barriers. The V-1 attacks ended on January 14, 1945. In sum, they killed 6,184 people and severely wounded an additional 17,987—a strategically compelling number of casualties for Allied commanders.³⁸

Peter Cooksley, author of *Flying Bomb*, captures the essence of the V-2 by titling one of his chapters "Death from the Stratosphere."³⁹ This supersonic weapon made Londoners "nostalgic" for the less destructive and demoralizing V-1 attacks.⁴⁰ Germany successfully launched 1,178 V-2s. Of these, a staggering 89% landed in Great Britain. The remaining missiles either fell in the North Sea, airburst over Britain, or broke up in the air.⁴¹ *None* of the missile were intercepted or defeated by Allied air defenses. The V-2 killed 2,541 and injured another 5,925 people.⁴² Compared to the V-1, each V-2 caused significantly more casualties. Each V-1 launched by the Germans caused approximately 2.3 casualties (injured and wounded); each V-2

³⁵ Collier, 367-70.

³⁶ Ibid., 373.

³⁷ Keegan, 281.

³⁸ Ibid., 284.

³⁹ Peter J. Cooksley, *Flying Bomb* (New York: Charles Scribner's Sons, 1979), 145.

⁴⁰ Ibid.

⁴¹ Ibid., 174-75.

⁴² Ibid.

on the other hand, caused 7.2 casualties. Similar to different categories of modern day adversary UAS, the V-1 was more prolific, but the V-2 was more destructive.

Intensity of the German V-weapon Threat: Relevant Characteristics of the V-Weapons

Although commonly linked together, the V-1 and V-2 are completely different weapon systems. The V-1 was a “flying bomb” powered by a rudimentary pulse-jet engine. The V-2 on the other hand, is what Sir John Keegan called a “direct ancestor” of the moon rocket.⁴³ The systems had unique characteristics, strengths, and weaknesses. The V-1 was a dependable, low-cost weapon. In 1944, it cost approximately 150 British Pounds (or approximately \$7,400 US Dollars today). German Soldiers primarily launched the flying bomb from a simple, fixed catapult. The weapon traveled at 400 mph and had a range of 150-200 miles.⁴⁴ The two primary strengths of the V-1 were its relatively simple design and, due to its low cost, the ability to produce large numbers of the weapon. Two weaknesses restrained the system: it required a static launch platform that the Allies could target and compared to the V-2 it was a short-range system.⁴⁵ These two weaknesses made the V-1 a static system that could only reach Britain from territories occupied by Germany along the northwestern coast of Europe. The V-1 was a capable, cheap, abundant weapon limited by its launch capability and range.

The V-2 was a true breakthrough. Rocket science enjoys respect in popular culture for good-reason—it is hard. Technical issues associated with the V-2 drove an extremely long developmental timeline. Even its launch base, the *Meillerwagen* was complex; Sir John Keegan stated it was as revolutionary as the rocket itself.⁴⁶ Unfortunately for the Allies, in 1945 the only defense against the V-2 was to occupy its launch sites. The Germans fired it from their national

⁴³ Keegan, 269.

⁴⁴ Ibid., 267.

⁴⁵ Ibid., 288.

⁴⁶ Ibid., 269.

boundaries, it flew a ballistic profile above Allied defenses, and it slammed into Earth with very little warning. Countries have developed modern day anti-ballistic missile systems to defeat threats similar to the V-2; these systems did not exist until well after the end of WWII. Although it had many strengths, the V-2 also had two primary weaknesses. Its long development process and high cost kept the V-2 out of the war until the outcome seemed decided. Additionally, once fielded, its storage and highly flammable fuel facilities were difficult to defend.⁴⁷ The V-2 was a revolutionary weapon for which there was no WWII post-launch defense. Thankfully for the Allies, the war ended and the V-2 ultimately had a lower impact than the V-1.

The characteristics of the V-weapons allow numerous conclusions. First, the V-2's technological superiority gave it a decided advantage over defensive systems of the time. This carries true throughout history. While defenses race to catch up when faced with a revolution in military affairs, the owner of the new technology possesses a unique advantage. Unlike the abnormal PO-2 incident, high-tech weapons are normally more difficult to defend against than low-tech alternatives. Second, the high cost of the V-2 system stole funds from the more economical V-1.⁴⁸ Hitler made a choice. He focused the resources at his disposal on the low-density, high payoff V-2. Had he chosen to focus on the high-density, lower payoff V-1, the overall effect of the V-weapons would have been higher.⁴⁹ State and non-state leaders make similar decisions on the purchase of UAS today. Third, the more technically advanced V-2 had a longer range. It gave Germany the option to attack London even after the Allies controlled the northwestern coast of Europe. Conversely, the lower-tech V-1 required a launch site close to its target. Higher technology weapons often give combatants more employment capability and operational reach than low-tech solutions. Finally, Sir John Keegan again provides keen insight.

⁴⁷ Cooksley, 147; Keegan, 288.

⁴⁸ Keegan, 288.

⁴⁹ Ibid.

He warns, “The world, nevertheless, had a very narrow escape.”⁵⁰ That narrow escape is from the disastrous possibility that a Germany equipped with both an atomic bomb and the V-weapons could have inflicted tremendous carnage. Because of their differences, the V-1 and V-2 posed different threats. As shown below, the same is true for varying types of UAS.

Allied Friendly Effort

Allied leaders and planners began developing the friendly air superiority scheme to counter the V-weapons *well before* Germany launched its first attack. Air Marshall Hill, who presided over the air defenses of the United Kingdom took the lead:

Thereupon Hill...produced an ‘outline plan’ which he submitted...in the middle of [December, 1943]. Observing that, despite the absence of a pilot who could be killed or incapacitated, the missiles would presumably be vulnerable to the same forms of attack as were used against ordinary aircraft, he recommended that fighters, guns, searchlights and balloons should all be used, and should be deployed in such a manner as to avoid causing mutual interference. At the same time he pointed out that the bombs—which were said to move at anything from 250 to 420 miles an hour—might well prove too fast for his fighters, and would in any case make difficult targets for anti-aircraft gunners. He asked, therefore, that the offensive against [launch sites] should be vigorously maintained, and that he should be kept informed of the progress made by two committees which were examining the chances of countering the missiles by radio-jamming.⁵¹

This quote captures the impressive foresight of the Allies and provides an outline for examining the Allied effort: *intelligence* warned them of the threat and its characteristics, they developed a *comprehensive DCA approach*, and they conducted *OCA attacks*.

Allied Friendly Effort: Intelligence

Air Marshall Hill’s thinking occurred six months prior to the first V-1 attack—this was an Allied intelligence victory. The Allies first learned of the German V-weapon threat from three primary sources: sympathetic informants observed initial V-1 and V-2 test flights, non-German laborers and prisoners provided large amounts of data, and scientists developing the weapons

⁵⁰ Keegan, 294.

⁵¹ Collier, 362-63.

secretly released information.⁵² One example is so-called Oslo report—an anonymous letter that contained a windfall of V-weapon intelligence—sent to a British Naval attaché.⁵³ The Allies treated this information as a very real threat and acted accordingly.

The Allies conducted a concerted effort to learn as much detail about the V-weapons as possible. Intelligence leaders decided they “must find out more about [the threat], and thus put themselves in a position to assess the threat that it presented.”⁵⁴ This effort was very fruitful. The Allies were able to locate the primary V-1 and V-2 production facility at Peenemunde in Northwestern Germany.⁵⁵ Additionally, British intelligence discovered the commander of the V-weapon units was Colonel Wachtel.⁵⁶ They began searching for any intelligence tied to the German leader. This effort led to the discovery of a large number of V-1 launch sites and more importantly to a detailed description of exactly what the launch facilities entailed. These two key pieces of intelligence directly enabled the OCA campaign against the V-1.

With this detailed intelligence in hand, the Allies acted. Excellent processing, dissemination, and understanding of the data led to the installation of radar stations, search and destroy attacks, and further planning. It is important to note that Allied intelligence planners and leaders shared information both laterally and vertically with positive results. The aggressive nature of intelligence collection, refinement of threat data, and adept handling of actionable knowledge, allowed the Allies to employ significant counter measures against the potential threat even before the first rocket or flying bomb launched.

⁵² Keegan, 260.

⁵³ Collier, 340.

⁵⁴ *Ibid.*, 341.

⁵⁵ *Ibid.*

⁵⁶ *Ibid.*, 357.

Allied Friendly Effort: Offensive Counter Air

Enabled by intelligence, the Allies conducted an aggressive offensive counter air campaign that while costly, delayed employment of the V-weapons and eventually ended their use. The OCA effort included both strategic bombing and the Allied ground advance. On August 17, 1943, Allied bombers attacked the Peenemunde production facility.⁵⁷ The bombing killed a large number of laborers and 120 members of the scientific staff, forcing the Germans to move the entire facility underground. However, the raid came at a high cost—forty of 600 Allied bombers were lost.⁵⁸ The Allies also attacked V-weapon launch sites. Twenty-four sites came under attack by 672 B-17 Flying Fortresses on Christmas Eve of 1943. The attacks had limited destructive impact but drove the Germans to develop alternate launch methods.⁵⁹

The overall effect of the bombing is hard to measure. Although the destructive results were not definitive, the changes forced by the bombing significantly delayed German V-weapon employment: “By the autumn of 1943...the attack on [Peenemunde] and the fortuitous destruction of a factory which made special vehicles for [V-1] launching-troops had extinguished the prospect that the weapon might go into service early in 1944.”⁶⁰ Not only did the bombers delay the initial V-1 launch, they also reduced the density of launches once they began. This reduction prevented Allied defenses from becoming saturated and made DCA measures more effective.⁶¹ While the bombings delayed the V-weapon attacks, the Allied ground assault eventually put an end to them. As early as September of 1944, nearly all V-weapon launch forces were retreating.

⁵⁷ Collier, 346.

⁵⁸ *Ibid.*; Keegan, 275.

⁵⁹ Keegan, 283.

⁶⁰ Collier, 347.

⁶¹ *Ibid.*, 381.

Allied forces eventually captured 1,368 V-1s and 3,002 V-2s.⁶² Nevertheless, was the Allied OCA effort worth the increased air superiority it enabled? As discussed earlier, committing OCA assets to one target naturally takes away from others. While Allied bombers were attacking V-weapon facilities, they were not attacking other strategic, operational, or tactical targets—this interdependency is an important consideration. The need to provide air superiority and to reduce the attacks on Great Britain drove decisions similar to the ones JFCs must make regarding commitment of assets against adversary drones today.

Allied Friendly Effort: Defensive Counter Air

In addition to enabling an OCA campaign, the impressive intelligence effort allowed the Allies to develop a comprehensive DCA plan. Initially, the plan called for fighter aircraft, anti-aircraft guns, and balloons to provide an integrated defense. Coordination between the guns and fighters was extensive. Altitude and geographic separation methods helped prevent friendly fire incidents but limited the effectiveness of both platforms.⁶³ The fighters took the primary responsibility, supported by the guns. The balloons were simply obstacles placed in likely V-1 flight paths; once airborne, they remained aloft 24 hours a day.⁶⁴ Sir John Keegan reports that, “Gun, fighter and balloon, defenses, deployed to a well-thought-out plan, achieved a measure of success from the outset.”⁶⁵ However, the defenses still could not achieve air superiority against the V-1. Collier found that “fighters were bringing down some thirty bombs a day, guns and balloons some eight to ten.”⁶⁶ Unfortunately, about fifty V-1s a day still struck their targets.

⁶² Collier, 381; Cooksley, 164.

⁶³ Collier, 380.

⁶⁴ *Ibid.*, 364.

⁶⁵ Keegan, 284.

⁶⁶ Collier, 373.

In response, the Allies sought to remedy the issue—they *desired* a higher level of air control. Air Marshall Hill, who personally flew several missions against V-1s, stated that the use of fighters against V-weapons was like “a very fast game played on a very small ground.”⁶⁷ Fighters employed against the V-1 had their paint stripped and engines modified to increase speed. Pilots developed new tactics to “intercept” the weapons. They would place themselves well above the flying bombs and use the extra altitude to gain sufficient speed. Daring aircrew even used their wings to tip over or nudge the V-1s thereby causing them to crash or sending them off course.⁶⁸ What is important to note about these tactics and modifications is that the ways and means existing before the employment of the V-weapons were not sufficient to combat the threat. Instead, revolutionary ideas and tactics allowed the Allies to adapt and shoot down V-1s.

The Allies also realized they required a new plan to solve the fighter-gun integration challenge. Air Marshall Hill, after much consultation with his staff and other leaders, elected to move all the anti-aircraft guns to a single belt along the English coast (thereby geographically separating the guns and fighters). The new plan worked. It allowed the fighters more freedom of movement and continued their responsibility for intercepts over the sea. The biggest advantage though was the increase in effectiveness of the guns. Their new coastal locations increased radar effectiveness. The lack of friendly fighters in the gun belts precluded delays in target identification. The result was a significant increase in overall effectiveness. On August 28, 1944, only five weeks after the new plan was put in place, “guns, fighters and balloons destroyed respectively 65, 23 and 2 flying bombs out of 97 which approached the country; and on that day only four reached London. By that date neither Hill nor the Germans could doubt that a substantial victory over Wachtel’s weapon had been won.”⁶⁹

⁶⁷ Collier, 373.

⁶⁸ Ibid., 369-75.

⁶⁹ Ibid., 380-84.

Driven by sound intelligence, the Allies developed an initial and comprehensive DCA plan. Although the plan enjoyed some success right away, it did not provide the level of air control desired by command authorities. Air Marshall Hill modified the plan and as fighter pilots and gun crews gained experience, they began enjoying significant success against the V-1.

German V-weapons and Allied Desired Control of the Air

Although the Allies put forth a significant effort to counter them, the German V1 and V2 challenged the concept of Allied air superiority during WWII. The Allies desired to protect Great Britain and its citizens from V-weapon attacks—it was in the national interest. The Allies desired at least air superiority over Great Britain. Basil Collier powerfully captures the V-weapon struggle between the Allies and Germany:

Although the resources allocated to the V-1 campaign did not have a significant impact on the progress by Generals Montgomery and Bradley, they did cause a big diversion of Anglo-American air striking power from tasks whose earlier achievement, some may think, might conceivably have hastened Germany's ultimate collapse...it is doubtless true that, from the standpoint of the enemy, a notable achievement of the campaign was that it induced the Western Allies to spend, and sometimes to waste, on objectives in France a heavy weight of bombs which they would otherwise have dropped on Germany.⁷⁰

Collier believes the V-weapons did not have a “significant impact” on land campaign progress. On the other hand, he contends the assets committed to deal with the V-1 and V-2 were a “big diversion” that slowed Germany's defeat. Stated another way, the assets committed by the Allies, and the V-weapon attacks themselves, did not directly impact fielded forces, but they did cause *prohibitive interference* to the overall Allied effort. Considered through today's doctrinal lens, the Allies enjoyed enough air control to conduct operations, but not enough to protect all of their interests. This placed them between air superiority and air parity on the doctrinal scale (Figure 1).

This level of air control came at a cost. The Allies put forth a significant effort to counter the V-weapon threat. Outstanding intelligence laid the groundwork. An OCA plan that included

⁷⁰ Collier, 397.

bombing attacks and enjoyed the success of Allied land advances helped delay the first V-1 launches and reduced the density of weapons the Germans were able to get airborne. The Allies also executed a very reasonable and well thought out DCA plan. When leaks in the defense occurred, they modified tactics and operational processes. Eventually, the combination of intelligence, OCA, and DCA provided an umbrella over Great Britain that addressed political and psychological requirements. However, each aspect of the friendly effort detracted from other tasks the assets could have accomplished in support of the broader war effort. The sole reason for committing these assets was the strategic protection of the British citizenry. Given the concept of US air superiority outlined above, future JFCs may feel compelled to commit a similarly significant effort to protect their forces or other US interests—even from enemy drones.

Adversary Unmanned Aerial Systems

The German V-weapons posed a significant albeit single-purpose threat that challenged the Allies in WWII. Adversary unmanned aerial systems pose a multi-purpose threat and present new, unique challenges to the US concept of air superiority. Air Force doctrine states, “UAS pose a significant threat to friendly forces and populations, and the ability to locate and destroy these systems prior to launch remains a challenge for effective Counterair operations.”⁷¹ The theoretical framework described above provides a lens to examine adversary UAS. The framework sheds light on the intensity and scope of the enemy threat by examining its characteristics, potential impact, and motivation for use. Using this lens helps shed light on the challenges associated with a US friendly counter-effort via DCA, OCA, and intelligence gathering. Finally, the theory identifies considerations regarding the JFC’s desired level of air control.

⁷¹ AFDA 3-01, 6.

Intensity of the Adversary Unmanned Aerial System Threat: Characteristics

Prussian military theorist General Carl von Clausewitz noted: “Many intelligence reports in war are contradictory; even more are false, and most are uncertain...In short, most intelligence is false.”⁷² Clausewitz’s words apply well to the rapidly evolving nature of unmanned aerial systems—new intelligence on characteristics is available on a frequent basis. The examples described herein mean to provide a general understanding of UAS proliferation.

Joint Publication 3-30 Command and Control of Joint Air Operations (JP 3-30) categorizes UAS into five groups (Figure 3). Group 1 systems are the smallest and slowest. Group 5 are the largest and fastest. Normally, as the group number increases, so does the

Unmanned Aircraft Systems Categorization Chart				
UA Category	Maximum Gross Takeoff Weight (lbs)	Normal Operating Altitude (ft)	Speed (KIAS)	Representative UAS
Group 1	0-20	< 1200 AGL	100 kts	WASP III, TACMAV RQ-14A/B, Buster, Nighthawk, RQ-11B, FPASS, RQ16A, Pointer, Aqua/Terra Puma
Group 2	21-55	< 3500 AGL	< 250	ScanEagle, Silver Fox, Aerosonde
Group 3	< 1320	< 18,000 MSL	< 250	RQ-7B Shadow, RQ-15 Neptune, XPV-1 Tern, XPV-2 Mako
Group 4	> 1320		Any Airspeed	MQ-5B Hunter, MQ-8B Fire Scout, MQ-1C Gray Eagle, MQ-1A/B/C Predator
Group 5	> 1320	> 18,000 MSL	Any Airspeed	MQ-9 Reaper, RQ-4 Global Hawk, RQ-4N Triton

Legend

AGL	above ground level	lbs	pounds
FPASS	force protection aerial surveillance system	MSL	mean sea level
ft	feet	TACMAV	tactical micro air vehicle
KIAS	knots indicated airspeed	UA	unmanned aircraft
kts	knots	UAS	unmanned aircraft system

Figure 3. Unmanned Aircraft Systems Category Chart

Source: JP 3-30 Figure III-15 on Page III-30

⁷² Clausewitz, 117.

complexity of design and cost. Figure 3 shows a marked difference at the break-over from Group 2 to Group 3 UAS. Groups 3-5 are similar in size and performance to manned aircraft. The US Air Force MQ-9 Reaper (Group 5) has a weapons payload of 3,750 pounds. Comparatively, the F-16 Fighting Falcon can carry two 2,000-pound bombs (or a combination of smaller munitions).⁷³ On the other hand, Group 1 & 2 UAS are more identifiable with remote control toys or hobby aircraft.

There are advantages and disadvantages of each group. Ted Harshberger, RAND Corporation Vice President and Director of Project AIR FORCE, noted the complexity of building Group 3-5 UAS, “It is *very difficult* to build long-endurance, highly automated, multi-role unmanned systems of the sort often purchased by the United States and its allies.”⁷⁴ Harshberger goes on to contrast the production of Group 1 & 2 UAS, “It is *extremely easy* to produce modest-endurance, partially automated, single-purpose unmanned systems.”⁷⁵ This analysis and the group structure help the United States anticipate the type of threat to expect from an adversary. Near-US peers possess the capability to develop Group 3-5 aircraft. Similar to the German V-2, this process would take longer and cost more, but produce a more capable platform. On the contrary, it is likely that nation-states with smaller defense budgets and/or a less capable aeronautics industry would produce UAS categorized in Group 1 or 2. This is even truer for non-state actors—they are most likely to purchase off-the-shelf technology or develop smaller UAS.

The joint publication group structure also allows further examination of specific threats. In his article titled “China Developing Unmanned Aircraft to Counter US Forces,” Kenji Minemura outlines a monetary competition in China to develop unmanned aircraft. Mr.

⁷³ United States Air Force Public Affairs, “Air Force Fact Sheets,” *United States Air Force*, no date provided, accessed June 18, 2014, <http://www.af.mil/AboutUs/FactSheets>.

⁷⁴ Ted Harshberger, “Expect More Drone Use Like Recent Israeli Episode,” *Rand Corporation*, October 11, 2012, accessed May 15, 2014, <http://www.rand.org/blog/2012/10/expect-more-drone-use-like-recent-israeli-episode.html>.

⁷⁵ Ibid.

Minemura points out that several of the competition's judges were Chinese military officials. The competition seems to have had a specific goal—the runway used for launch and recovery was 25% of the size of the deck of the Varyag, China's first aircraft carrier.⁷⁶ Minemura believes Beijing "is forging an 'access denial' strategy to prevent the United States from approaching waters around China and intervening in potential conflicts between China and Taiwan."⁷⁷ In April 2012, a Japanese P-3 maritime surveillance aircraft photographed a Chinese warship and Group 2 UAS conducting integrated blue-water operations. Finally, China possesses highly technical UAS that are capable of electronic intelligence processing and targeting.⁷⁸ Given the current US focus on the Pacific, these Chinese capabilities require significant consideration.

Closer to home, authorities arrested Rezwan Ferdaus, a US citizen, in September, 2011 for attempting to conduct an attack on the Pentagon and the US Capitol building with a pair of Group 2 drones. Ferdaus outfitted small-scale, remote control replicas of F-4 Phantom and F-86 Super Saber fighter aircraft with five pounds of plastic explosives (Figure 4).



Figure 4. Rezwan Ferdaus' Remote Control F-86 with Five Pounds of Plastic Explosive

Source: USA Today.

⁷⁶ Kenji Minemura, "China Developing Unmanned Aircraft to Counter U.S. Forces," *The Asahi Shimbun*, January 24, 2012, accessed February 8, 2014, <http://ajw.asahi.com/article/asia/AJ201201240041>.

⁷⁷ Ibid.

⁷⁸ Roger Cliff, John Fei, Jeff Hagen, Elizabeth Hague, Eric Haginbotham, and John Stillion, "Shaking the Heavens and Splitting the Earth," *Rand Corporation* (2011): 100.

He planned to use GPS guidance after launching the aircraft from the National Mall in Washington DC. He attempted to employ personally modified, low cost, off-the-shelf technology.⁷⁹ Certainly, non-state actors could follow a similar strategy to target US interests.

Other countries and militant organizations are also employing UAS. In 2006, Hezbollah used an Iranian built Group 3 Ababil UAS in an attempt to attack an Israeli installation.⁸⁰ Currently, Iran is working to develop ten new types of drones from different categories. One of their existing systems, the Mohajer, “can carry as much as 50kg of explosives.”⁸¹ India plans to build 400 Group 1 & 2 drones and seeks to construct 100 Group 3-5 UAS. Their neighbor Pakistan refuses to fall behind; it is developing a wide variety of UAS ranging from the smaller truck-launched Group 2 Huma to the Group 3 Eagle Eye.⁸² UAS of all shapes, sizes, cost, and capability are proliferating across the globe.

Intensity of the Adversary Unmanned Aerial System Threat: Potential Effects

The characteristics of a UAS drive but do not define the impact it can have. Drones have the capability to inflict physical destruction, conduct intelligence gathering, and disrupt friendly efforts. The psychological aspects of these effects should not be underestimated. A political incident involving German Chancellor Angela Merkel and the use of a Group 1 drone by rebels during the 2011 Libyan civil war are examples of the potential effects of UAS.

⁷⁹ Kevin Johnson, “Man Accused of Plotting Drone Attacks on Pentagon, Capitol,” *USA Today*, September 28, 2011, accessed June 3, 2014, <http://usatoday30.usatoday.com/news/washington/story/2011-09-28/DC-terrorist-plot-drone/50593792/1>.

⁸⁰ David Johnson, “Hard Fighting Israel in Lebanon and Gaza,” *Rand Corporation* (2011): 54, 90.

⁸¹ Peter Singer, “A Revolution Once More: Unmanned Systems and the Middle East,” *Brookings Institute*, November 10, 2009, accessed June 4, 2014. <http://www.brookings.edu/research/articles/2009/10/11-robotic-revolution-singer>.

⁸² *Ibid.*

In 2013, the German Pirate Political Party employed a Group 1 drone in and around a campaign event attended by Chancellor Merkel. The small, remote control drone initially circled the venue demonstrating its capability to observe the event from a distance. Soon thereafter, the operator flew the drone to within a few feet of Chancellor Merkel's podium (Figure 5).⁸³



Figure 5. Pirate Party Group 1 Drone and Chancellor Angela Merkel

Source: Business Insider.

Authorities quickly arrested the operator of the UAS, but the damage was already done. In this case, the effect was political embarrassment for Chancellor Merkel and positive messaging for the Pirate Party. Nevertheless, this event is a Secret Service and force protection nightmare. Had a group with more evil intent armed the drone with a small explosive, chemical, or biological weapon, its proximity to Chancellor Merkel and other attendees would have been life threatening. Additionally, the disruption caused by the drone detracted from Chancellor Merkel's desired event goals—the drone adversely affected her *desired end state*. Transferring these effects to a US forward operating base or key leader engagement has obvious implications. In his airpower theory, Col Warden stated two points that apply, “precision has changed the face of warfare” and “command is a true center of gravity and worth attack in any circumstance in which it can be

⁸³ Jason Bittel, “German Pirate Party Uses Drone to Crash Event with Chancellor Angela Merkel,” *The Slate*, September 18, 2013, accessed June 3, 2014, http://www.slate.com/blogs/future_tense/2013/09/18/german_pirate_party_uses_%20drone_to_crash_event_with_chancellor_angela_merkel.html.

reached.”⁸⁴ The precision provided by a UAS against a civilian commander like Chancellor Merkel is vastly different from the imprecise nature of the German V-weapons. The Pirate Party’s UAS proved to be a potential low-cost, high precision, and high yield weapon.

Destruction and political embarrassment are not the only effects a UAS can achieve. During the 2011 civil war in Libya, a lead rebel group known as the National Transitional Council recognized a dire need for operational intelligence. Although the rebels had support from the North Atlantic Treaty Organization (NATO), they did not have direct access to NATO’s often-classified data. To remedy this shortfall, they procured and operated a Group 1 drone known as the “Scout” in support of combat operations (Figure 6).⁸⁵



Figure 6. Rebel Aeryon Scout Imagery of Libyan Artillery Position; Aeryon Scout Drone

Sources: UAS Vision and Canadian Awareness.

⁸⁴ Warden, 46, 149.

⁸⁵ Ian Austen, “Libyan Rebels Reportedly Used Tiny Canadian Surveillance Drone,” *New York Times*, August 24, 2011, accessed June 15, 2014, http://www.nytimes.com/2011/08/25/world/africa/25canada.html?_r=1&.

Aeryon, a Canadian controlled private corporation, produces the Scout. The Scout is transportable by backpack, uses a point and click, map-based operating system that requires very little training, and carries a day/night high-fidelity camera payload.⁸⁶ A video, produced by Aeryon and widely available on the Internet, displays the use of the drone during the Libyan civil war.⁸⁷ The rebels used the Scout as a reconnaissance platform during day and night operations. Scout operators located and observed Libyan artillery units, tracked Libyan ground forces, and helped coordinate rebel operations.

The National Transitional Council's acquisition of the Scout is enlightening. The Scout costs approximately \$120,000. Acquiring the funds to purchase the drone required external financing and donations.⁸⁸ Delivering the drone to the rebels was also a complex process. Charles Barlow, a private security firm operator, served as the rebel's intermediary:

Canadian military vet, Charles Barlow, brought [the Scout drone] personally into [Libya]. Armed with a Canadian export license and the backpack-sized Scout, Barlow boarded a retrofitted tuna boat at Malta that was used to send humanitarian aid to [Libya] despite NATO's maritime blockade in late July. As far as Barlow is aware, Canada licensed the drone for sale to the Libyan rebels, but NATO didn't know that the boat carried it into port, even after multiple hailings by NATO vessels.⁸⁹

The entire incident is striking. First, a small, revolutionary minded group identified an operational need and developed a plan to meet their requirement. Second, although the group could not afford the technology, sympathetic outsiders provided the necessary funds. A third party purchased the drone from a reputable, first-world company. Next, Canada granted an export license without any indication it consulted its NATO partners. Fourth, the third party conducted all of the training and

⁸⁶ No joysticks or other pilot-type inputs are required. The operator touches a map on a handheld tablet to direct the drone's destination.

⁸⁷ Aeryon Scout video available at: <http://www.youtube.com/watch?v=DQ3hEt0EOkc>.

⁸⁸ Austen, 1.

⁸⁹ Spencer Ackerman, "Libyan Rebels Are Flying Their Own Minidrone," *Wired*, August, 23, 2011, accessed June 3, 2014, <http://www.wired.com/2011/08/libyan-rebels-are-flying-their-own-mini-drone/>.

logistics required for the rebels to operate the system. Finally, although it is a Group 1, relatively low-cost drone, the Scout very capably filled the rebels' operational requirement. Imagine a US adversary using a similar procurement process and tactic to: take nighttime video of US artillery formations and then target them with indirect fire; or examine the perimeter defenses of a US facility prior to attacking; or provide advance warning of a US cordon and search operation. These actions would certainly constitute prohibitive interference given today's US concept of air superiority.

Intensity of the Adversary Unmanned Aerial System Threat: Motivation

The characteristics of adversary UAS tell what they can do. The potential effects indicate where and when adversaries might employ a drone. The adversary *motivation* to utilize drones provides the *why*. The single largest reason adversaries might employ a UAS is because the United States has a vulnerability to drones. Compounding this problem, drones are comparatively easy to operate. For states and non-state actors that normally face the United States from a position of relative disadvantage, UAS can level the playing field.

The US Army's Fires Center of Excellence at Fort Sill, Oklahoma, produces a document titled "United States Army Counter-Unmanned Aircraft System Concept of Operations (C-UAS CONOPS). It highlights the military problem adversary drones pose:

Army forces have a limited capability to **detect, identify, and defeat** adversaries' increasingly sophisticated and robust tactical Unmanned Aircraft Systems. No single Army warfighting function has the capability, from both a proficiency and sufficiency standpoint, to defeat the UAS threat at the tactical level. The Army must provide [counter-UAS] capabilities integrated across the Army's warfighting functions and joint capabilities. [emphasis in original]⁹⁰

The vulnerability is not limited to the Army. Across the US joint force, numerous challenges to countering adversary drones exist. Currently, the US military does not have the proficiency or

⁹⁰ Fires Center of Excellence, *United States Army Counter-Unmanned Aircraft Systems Concept of Operations* (Lawton, OK: Fires Center of Excellence, 2014), 7.

sufficient systems to detect, identify, and defeat the adversary UAS threat. Instead of its normal technological superiority, the United States is experiencing relative technological parity.

Unfortunately, adversary accessibility amplifies US vulnerability. Drones are low cost to operate from both a personnel and logistical perspective. When friendly forces shoot down a manned enemy aircraft, they often kill or capture the pilot. Destroying a UAS no longer has the added impact of removing its operator. Previously, adversaries had to replace both man and system. In many cases, it is much easier to replace the vehicle than to train the man. This is certainly true with low cost UAS. Training and proficiency requirements are also significantly lower. When Barlow delivered the Scout UAS to the Libyan rebels, he trained them for only a day and a half with very successful results: “I was amazed how easy it was to train people with no previous UAS or aircraft experience, especially given the language barrier.”⁹¹ UAS, especially from Group 1, are an accessible, low cost, low sustainment weapons system.

If vulnerability and accessibility are not daunting enough, consider the negative psychological impact of adversary UAS. In 2004, Hezbollah flew a Group 3 Mirsad-1 drone into Israeli airspace. After the successful incursion and return to Lebanon, Hezbollah chief Hassan Nasr Allah said, “It does not have the capacity of only reaching Nahariya, but deeper and deeper, against electricity and water installations and military bases.”⁹² Hezbollah’s leadership is using its drones *strategically*. History suggests even a single airstrike can have tremendous impact. General Jimmy Doolittle’s small force of sixteen B-25 bombers had little destructive effect on their Japanese targets in WWII, but shook the psyche of Japanese citizens. In response, the Japanese government committed significant resources to protect its citizenry from further attacks.

⁹¹ UAS Vision, “Libyan Rebels Use Aeryon Scout to ‘See Over the Hill,’” *UAS Vision*, August 24, 2011, accessed June 1, 2014, <http://www.uasvision.com/2011/08/24/libyan-rebels-use-aeryon-scout-to-see-over-the-hill/#sthash.fjWli3WR.dpuf>.

⁹² Aljazeera, “Hizb Allah: Our drones can hit Israel,” *Aljazeera*, November 12, 2004, accessed July 9, 2014, <http://www.aljazeera.com/archive/2004/11/2008410115611956515.html>.

These withheld resources weakened Japan's war effort on other fronts.⁹³ As seen above, German V-weapons had a similar impact. Adversary UAS pose a noteworthy psychological threat.

US Friendly Effort: Defensive Counter Air

Although they posed a single-purpose destructive threat, the German V-1 and V-2 challenged Allied defensive counter air systems in distinctly different ways. The multi-purpose threat from adversary UAS is very similar. Before Germany fired the first V-1, the Allies possessed the fighters, anti-aircraft artillery guns, and radar systems needed to defend against the lower cost and lower technology weapon. On the other hand, the Allies did not possess a defensive system capable of countering the high-tech, expensive V-2. The adversary UAS threat currently faced by the United States provides the *opposite problem*. The United States has a reasonable capability to counter the expensive and more capable Group 3-5 UAS. On the other hand, the Group 1 & 2 UAS present a unique challenge that current US air superiority assets have limited ability to counter—this is reminiscent of the PO-2 discussed at the outset of this thesis.

The quote from the US Air Force posture statement above recognizes sixty years of success in countering adversary air threats. As air threats evolved, the United States developed current systems like the F-15, F-22, and Patriot to provide air superiority. The United States has a proven capability to conduct defensive counter air against enemy fighter and bomber aircraft; US assets can find, fix, target, track, and engage these threats. Fortunately, fighter and bomber threats have capabilities similar to the Group 3-5 UAS. The United States and other near-peer nations have effectively engaged larger UAS. For example, in 2009, two US Air Force F-16 Fighting Falcons shot down an Iranian Ababil-3 drone. The Ababil, a Group 3 UAS capable of carrying a forty-five kilogram warhead, was unarmed but conducting reconnaissance six miles inside Iraq. The Fighting Falcons found and tracked the UAS for seventy minutes before engaging it over an

⁹³ Warden, 44.

uncongested area.⁹⁴ Russia has also demonstrated this capability against a Georgian owned, Israeli made Hermes-450 Group 3 UAS. In 2008, a Russian fighter aircraft shot down the Georgian drone while it was conducting reconnaissance against anti-Georgian rebels.⁹⁵

These two incidents convey important considerations. First, the fighters were able to detect the UAS. Modern air superiority aircraft possess on board radars that work well against targets at higher airspeeds. Unfortunately, ground clutter and other radar limitations often prevent detection of slow moving targets. Group 3-5 UAS move fast enough that current US air superiority assets can detect them. Group 1 & 2 drone airspeeds make them very difficult to detect.⁹⁶ Second, the fighters met their identification criteria—or rules of engagement—allowing them to fire. Again, it is easier to identify Group 3-5 UAS than smaller drones:

Identification is the process of determining the friendly or hostile character of an unknown detected contact through visual, procedural, and/or electronic means. Identification challenges for threat UAS include: congested airspace, poor airspace control, lack of [Identification Friend or Foe systems] on friendly UAS, and similarities (visual and electronic) between friendly and threat UAS.⁹⁷

This excerpt from the Counter-UAS CONOPS explains the difficulty of the identification process. The smaller the UAS, the harder it is to see. The smaller the UAS, the more difficult it is to equip with Identification Friend or Foe electronic systems. These identification challenges are not limited to fighter platforms—the same challenges apply to other ground and air systems attempting to counter adversary UAS. Group 3-5 UAS are difficult to detect and identify, but the

⁹⁴ Michael Hoffman, “F-16 shot down Iranian drone in February,” *Air Force Times*, March 16, 2009, accessed May 20, 2014, <http://www.airforcetimes.com/article/20090316/NEWS/903160301/F-16-shot-down-Iranian-drone-February>.

⁹⁵ Rebecca Grant, “RPAs For All,” *Air Force Magazine*, August 2012, accessed May 15, 2014, <http://www.airforcemag.com/MagazineArchive/Pages/2012/August%202012/0812RPAs.aspx>; Video of a Russian fighter aircraft downing a Hermes 450 Group 3 UAS is available on several internet sites including: <http://www.youtube.com/watch?v=-uyTFPwSXUI>.

⁹⁶ For an extensive discussion on radar theory, Martin Schetzen’s book *Airborne Doppler Radar Applications, Theory, and Philosophy* (Virginia: American Institute of Aeronautics and Astronautics, 2006) is thorough reference.

⁹⁷ Fires Center of Excellence, 10.

United States has systems capable of the task. Unfortunately, Group 1 & 2 UAS are almost impossible to detect and identify with current US systems.

Similar to the DCA changes the Allies made in WWII, difficulties in countering UAS are forcing changes and development in US systems and processes. In September 2013, the US Air Force's 605th Test and Evaluation Squadron conducted a joint exercise to test modernization upgrades to the radar onboard the E-8 JSTARS aircraft. Historically, the E-8 has tracked terrestrial and maritime targets. However, the recent radar upgrade enables it to track low, slow, small targets like drones or ultra-lights.⁹⁸ The JSTARS upgrade "significantly improves radar resolution of moving target indications; giving the user a clearer picture of what's moving on the ground and *now up to several thousand feet above the ground.* [emphasis added]"⁹⁹ Once completely implemented in the fielded force, this capability will give the US a command and control asset capable of detecting and tracking Group 1 & 2 UAS.

The US Army, Navy, and Marines are also seeking to acquire DCA systems capable of countering smaller drones. In February 2014, the US Army submitted a query on affordable counter-UAS systems. Both the Navy and the Marine Corps are developing laser systems capable of engaging UAS.¹⁰⁰ Like the entire US concept of air superiority, the counter-UAS fight is an inherently joint endeavor. Commenting on counter-UAS exercises, Colonel (Ret.) Matthew Neuenswander, Director of the LeMay Center's Joint Integration Directorate, wrote, "From the outset, the UAS experts guided the AF/Army team towards a joint solution that linked air and ground based radar, optical, and electronic sensors from multiple services to create a common

⁹⁸ Sonja Suarez, "JSTARS participates in counter UAV exercise," *Patrick Air Force Base Public Affairs*, September 11, 2013, accessed May 18, 2014, <http://www.patrick.af.mil/news/story.asp?id=123362860>.

⁹⁹ Ibid.

¹⁰⁰ Office of Naval Research, "Ground-Based Air Defense Directed Energy On-The-Move," Special Notice 13-SN-0014 (2013):1-2; Naval Sea Systems Command Public Affairs, "Navy Laser Destroys Unmanned Aerial Vehicle in a Maritime Environment," *America's Navy*, May 5, 2010, accessed July 9 2014, http://www.navy.mil/submit/display.asp?story_id=53705.

operating picture enabling UAS defense.”¹⁰¹ These joint systems and exercises are a sampling of a large, ongoing effort to close the gap between the adversary’s ability to employ Group 1 & 2 UAS and the United States’ ability to defeat them.

Today, US DCA platforms can defeat UAS threats that only near-peers are likely to employ; these systems show parallels to the German V-2 in that they are more expensive and take longer to develop. On the contrary, the United States is still developing systems to counter the smaller, less expensive UAS available to non-state actors or rogue nations. Overall, in WWII, the V-1 had more impact than the V-2. The Allies were capable of meeting this most likely and most threatening adversary weapon. Unfortunately, in 2014, the United States cannot yet say the same.

US Friendly Effort: Offensive Counter Air

As Warden points out, “The most serious drawback to defense, however, is that it is a negative concept—by itself it can lead at best to a draw, never to a positive result.”¹⁰² Warden and Clausewitz seem to agree that the defense is a negative aim. As shown above, the US ability to conduct DCA against drones is still developing. Additionally, the Allies showed that offensive counter air was an effective means of defeating both the high and low-tech V-weapon variants. OCA is a promising counter to UAS. However, it presents unique challenges all its own.

Colonel Neuenswander believes UAS should be part of the joint OCA targeting plan.¹⁰³ During Fort Sill’s “Earth Wind and Fire” joint exercises in 2008 and 2009, participants realized that waiting to target enemy UAS until they were over the battlefield was too late. The airspace over a friendly ground maneuver force is a complex, dense environment. It is already extremely challenging to avoid conflicts among friendly fixed wing, rotary wing, and fires assets. Enemy drones in this airspace further complicated the endeavor. Additionally, friendly fighters

¹⁰¹ David Neuenswander, “Wargaming the Enemy Unmanned Aerial System Threat,” *Fires Journal*, (November-December 2012): 61.

¹⁰² Warden, 22.

¹⁰³ Neuenswander, 62.

attempting to target the adversary drones added to the fray. Neuenswander points out that adversary UAS are part of the enemy air threat and, in accordance with joint doctrine, the United States should destroy them on the ground.¹⁰⁴ The benefits of targeting adversary UAS on the ground are clear. Destroying enemy drones prior to launch precludes the negative impacts discussed throughout this document. However, it is important to remember that OCA comes at a cost. If the JFC orders adversary drones added to the joint integrated prioritized targets list (JIPTL), another enemy capability may go untargeted. With limited resources, joint OCA assets cannot target everything. During WWII, the Allies had to decide if targeting V-weapon facilities was more important than conducting activities like close air support and the combined strategic bombing offensive. Adding UAS to the JIPTL requires the JFC to make a similar decision.

Knowing where to target adversary drones represents another OCA challenge. Unlike traditional OCA targets, drones require less infrastructure and are easier to conceal. This is especially true for Group 1 & 2 UAS. Colonel Warden explains a chain of events required for the enemy to employ a traditional aircraft. The first link is gathering the raw materials. The next step is assembling them in a physical location. Then, the new aircraft may require relocation before the pilot or operator takes the airplane aloft. Warden wrote, “Theoretically, it is possible to eliminate an air force by successful attacks on any point in this chain.” Applying these steps to adversary UAS highlights the increased difficulty. First, the raw materials required to build a model of an F-86 (Figure 4) are obviously easier to acquire and conceal than those needed to build a full-size Super-Saber. Continuing with this thinking, the assembly facility, runway, and transportation requirements are all notably lower with UAS. The exact characteristics that make drones accessible to non-state actors are the same ones that cause the United States problems.

While conducting OCA against adversary UAS is difficult, Israel proved it is not impossible. In 2012 and 2013, the Israeli Defense Force bombed underground facilities used by

¹⁰⁴ Colonel Neuenswander quoted relevant passages from JP 3-01 and JP 3-60.

Hamas to develop and produce tactical UAS.¹⁰⁵ Israel conducted these attacks because they feared Hamas would use drones in a similar fashion to consistent rocket attacks against civilian and military targets. Israel recognized the negative psychological impact of drone attacks. Adversary UAS were high enough on Israel's priority list to risk the collateral damage associated with the bombings and to allocate the precious resources required to carry out the attack. Warden and Clausewitz would call the use of offensive counter air against adversary UAS a positive concept. Effective OCA can preclude adversary drone attacks and interference. However, OCA against drones is difficult due to the simplicity of the entire UAS production to execution process.

US Friendly Effort: Intelligence and Coordination

The Israeli raids on Hamas UAS stockpiles would have been impossible without actionable intelligence. Israel conducted precise attacks on facilities located by their intelligence network. The coordination required to conduct such an attack requires significant planning and infrastructure. Preventing adversary UAS attacks requires a systematic, coordinated intelligence effort. Just like the Allies during WWII, the United States is seeking to meet this requirement.

The first example of this US effort resides in the Fires Center of Excellence's Counter-UAS CONOPS. The document lists several tasks the intelligence community performs to enhance US efforts against adversary drones. Detection and tracking of airborne drones are two important roles, but even prior to adversaries launching a drone, key intelligence activities must occur. Planning by intelligence personnel allows the Army to focus sensors along likely detection axes. Additionally, dissemination of threat UAS capabilities arms the joint force with the tactics, techniques, and procedures intelligence analysts expect the adversary to employ. Finally, friendly intelligence assets must coordinate the collection, processing, and exploitation of adversary UAS.

¹⁰⁵ World Tribune, "Israel Bombs Hamas Drone-making Sites in Gaza," *World Tribune*, April 25, 2013, accessed June 8, 2014, <http://www.worldtribune.com/2013/04/25/israel-bombs-hamas-drone-making-sites-in-gaza/>.

Like any other intelligence target, drones must be included and given a priority in the larger collection plan.¹⁰⁶ These intelligence procedures allow the joint force to act. They enable joint fires to attack drone points of origin with deliberate and dynamic targeting. Moreover, they frame how the adversary uses its UAS and empower US ground force reaction.¹⁰⁷

Intelligence is only one side of the coin; countering adversary UAS also requires significant coordination. Traditionally, two primary ways the United States achieves a high level of coordination are through joint exercises and integration cells—the counter-UAS fight follows this successful practice. First, the US military conducts an annual counter-UAS exercise named Black Dart. The objectives of the Black Dart exercises are three fold: first, execute live fire demonstrations against actual drones to assess current Integrated Air and Missile Defense capabilities; second, to develop counter-UAS operational concepts and architectures; third, to provide information and feedback into the counter-drone roadmap.¹⁰⁸ Black Dart provides the United States with the opportunity to test coordination across the spectrum. From assessment to detection to identification to destruction, US assets coordinate to defeat actual airborne UAS simulating threat systems. The United States is actively working to *practice* coordination in a training environment in an attempt to achieve *perfection* on the battlefield.

The United States is not confining UAS coordination to dedicated drone-focused exercises. In fact, simulated adversary UAS now participate in premiere joint training at Fort Irwin’s National Training Center (NTC). NTC provides “realistic joint and combined arms training” to “identify unit training deficiencies...and prepare for success on the future joint

¹⁰⁶ Fires Center of Excellence, 9-13.

¹⁰⁷ Ibid., 10-22.

¹⁰⁸ Michael Daggitt (Headquarters US Air Force Plans Directorate point of contact for counter-UAS), email message to the author, May 14, 2014.

battlefield.”¹⁰⁹ In fact, NTC is a capstone exercise that finalizes a unit’s combat readiness prior to a deployment. NTC requires participants to integrate joint fires and control congested airspace. During NTC rotation 12-05 (during the middle of Fiscal Year 2012), NTC adversary forces used drones in a very similar fashion as the Libyan rebels discussed above. They used the drones to answer priority information requirements on the location of US ground forces. The adversary drones found numerous armored vehicles belonging to the friendly reconnaissance force. The drones cued adversary ground elements that then engaged and (in the simulation) “destroyed” the friendly vehicles.¹¹⁰ The adversary drones were highly effective at locating friendly forces and providing their location to “enemy” commanders. Unfortunately, the friendly force was unable to shoot down any adversary UAS or to disrupt their command and control facilities.¹¹¹ In this exercise, coordination to identify and engage adversary UAS proved very difficult. As a result, the drones prohibitively interfered with the friendly scheme of maneuver.

During WWII, Allied intelligence and coordination assets provided critical information and control that enabled both OCA and DCA efforts to counter the V-weapon threat. The Fires Center of Excellence guidance provided one example that the United States understands the critical role of intelligence in the modern-day enemy drone fight. Additionally, US exercises like Black Dart and NTC provide a proving grounds for coordination against enemy UAS; sometimes these efforts enjoy success and sometimes they show vulnerabilities. The United States recognizes the need for intelligence and coordination—it is seeking to improve its capability.

¹⁰⁹ United States Army Public Affairs, “NTC Mission,” *Fort Irwin Website*, no date provided, accessed May 30, 2014, <http://www.irwin.army.mil/Visitors/Info/Pages/MissionandVision.aspx>.

¹¹⁰ NTC uses an electronic system that allows the adversary and friendly forces to engage each other with non-lethal laser technology. The system determines if a “kill” would have occurred in a real world scenario. It is important to note this is not a computer simulation...the vehicles and aircraft are actually maneuvering on a battlefield. As a vastly oversimplified comparison, the system is similar to a Laser-tag game.

¹¹¹ Mission summary of adversary UAS during National Training Center Rotation 12-05 as reported by the red force UAS commander.

The Effect of UAS on US Desired Level of Air Control

Based on evaluation of the two variables above—Intensity of the Adversary Unmanned Aerial System Threat and US Friendly Effort—adversary UAS currently have the capability to prohibitively interfere with the US concept of air superiority. Adversary drones threaten US air superiority from both a psychological and military perspective. In his article, “Why Big Nations Lose Small Wars,” Andrew Mack outlines why large, militarily strong nations lose asymmetric conflicts to smaller entities or insurgencies. He poignantly argues these conflicts are won, or more often lost, on the domestic battleground of the larger power.¹¹²

When terrorists attacked the United States on September 11, 2001, American passion stirred. As a result, two major wars occurred and the US military suffered more casualties than those caused by the initial terrorist attacks. An adversary UAS attack could have a similar psychological impact. A drone attack against a US forward operating base or tactical formation could cause significant casualties. However, in a very callous assessment, these casualties likely would not stop the US military from achieving its operational objectives. The casualties would represent a small portion of the total US military force. Nevertheless, would the US citizenry accept these losses? An attack from the air against US forces is such a foreign concept that it could drive investigations and public outrage. The strategic, psychological impact of an adversary drone attack killing scores of US ground forces would cause one of two things—a desire by the US citizenry for revenge or a lack of will to continue fighting. Regardless, both of these attitudes could prohibitively interfere with the JFC’s ability to achieve the desired military end state. If these attacks occurred against a non-military target, the psychological impact would be even greater. Israeli Prime Minister Benjamin Netanyahu sheds light on the strategic effect and implications of enemy drones. In response to a threatening drone flown over Israel in 2013, he

¹¹² Andrew Mack, “Why Big Nations Lose Small Wars: The Politics of Asymmetric Conflict,” *World Politics* 27, no. 2 (1975), 175-200.

labeled the incursion “a very serious issue” that carried the “utmost gravity.” He went on to state that Israel would “do everything necessary to safeguard the security of its citizens.”¹¹³ Small drones can have big strategic impact.

Although the psychological impact of UAS may be compelling enough, there are additional adverse military effects. Viewed from an operational perspective, loss of US freedom of maneuver is unacceptable to military commanders. Col Neuenswander’s research shows the mindset of US ground force leaders, “[during exercises,] when the enemy could consistently fly UAS systems in the vicinity of friendly ground forces, the supported commanders generally felt the enemy UAS were a ‘prohibitive interference.’”¹¹⁴ Ground commanders do not want adversary drones, like those employed by the Libyan rebels, over their forces. Additionally, enemy drones cause significant problems in an area where the United States traditionally dominates:

“Observations have shown that even a few enemy UAS over a ground commander’s AO can cause airspace control to break down.”¹¹⁵ This breakdown limits US ability to employ airpower and joint fires—negating what is traditionally a definitive US advantage.

Both the psychological and operational impacts of adversary UAS violate the US concept of air superiority. The United States traditionally establishes theater-wide air superiority through mostly offensive means. For the last sixty years, this tradition resulted in immunity for US ground forces from attack by enemy aircraft. However, the adversary UAS threat, especially from Group 1 and 2 drones, provides a unique challenge. Unlike the German V-2, but similar to the Korean PO-2, the inexpensive, widely available, easy to manufacture Group 1 and 2 UAS are the most difficult to target. Unfortunately, they pose a significant and potentially prolific threat. In fact,

¹¹³ Michele Chabin, “Hezbollah Denies Sending Drone Shot by Israel,” *USA Today*, April 25, 2013, accessed 3 June 2014, <http://www.usatoday.com/story/news/world/2013/04/25/israel-hezbollah-drone/2112127/>.

¹¹⁴ Neuenswander, 61.

¹¹⁵ *Ibid.*

Group 1 and 2 UAS pose the *highest threat* given the lack of US means to identify, detect, and destroy them. In order to be strategically effective, an adversary drone only has to achieve one offensive success, at one location, at one time. This places the United States in a situation where it must defend everywhere, all the time.

The airpower theorists discussed above believe a defense of this magnitude is impossible. Instead, they recommend offensive action to preclude the enemy's ability to fly. During WWII, the Allies used a combination of offensive counter air and defensive counter air empowered by intelligence to mitigate the German V-weapon threat. The Allies committed valuable resources (that could have aided other aspects of the war effort) to protect British citizens. They did this because the V-weapons were strategically compelling. A modern-day Joint Force Commander would face a similar decision when threatened by adversary UAS. The current capability to counter adversary UAS would require the JFC to commit tremendous resources to provide protection from enemy drones. Given the current understanding of US air superiority—that no loss of life or loss of freedom of maneuver is acceptable—the JFC would be compelled to make this level of commitment. However, is this the best decision? The JFC must balance the interdependence and complexity of the psychological and operational need for air superiority against the assets committed and other military objectives.

Thus, the United States has two options: redefine the US concept of air superiority or commit the resources required to achieve a robust capability to counter adversary drones. The US has already started the effort to counter adversary UAS. The systems and intelligence efforts discussed above are very positive steps. If the United States chooses to continue its counter-UAS trajectory, it can develop the capability to extend the sixty years of air superiority it currently enjoys. However, the United States must also address its vulnerability to enemy drones in both the military and public spheres. If, in the current fiscal environment, the United States chooses not to commit the large amount of funds required to develop counter-UAS systems and procedures, it must redefine the concept of air superiority. Ground forces should be ready to

conceal their vehicles. Soldiers should practice telling the difference between friendly and enemy drones. Secret service agents and security personnel at sporting events should consider similar tactics. The United States must also inform its public. In the absence of a robust counter-UAS capability, military members and US citizens are vulnerable. Currently, the intensity of the enemy threat compared to the available US friendly effort results in an air control level that does not stand up to the US concept of air superiority (Figure 1).

Conclusion

This monograph sought to answer the following primary research question: how do adversary unmanned aerial systems affect the US concept of air superiority? As an emerging threat, adversary UAS pose a unique challenge to the US concept of air superiority. Adversary drones have the potential to be a sporadic but deadly and psychologically powerful weapon. Adversary UAS could *prohibitively interfere* with the current concept of US air superiority and with US air, sea, and land operations. Two primary research findings support this hypothesis. First, the United States is currently vulnerable to adversary drones—especially from Group 1 & 2 UAS. These drone incursions could have multiple-effects including loss of life, degraded freedom of movement, and increased enemy reconnaissance. Non-state actor and rogue nation access to these low-cost, easy to produce, easy to operate weapons heightens US vulnerability. Second, the US concept of air superiority is a deeply rooted belief that sustained, theater-wide, joint, and primarily offensive operations can preclude enemy attacks from the air—as they have for the last sixty years. This concept is so ingrained that loss of personnel and freedom of movement seems unacceptable. An adversary UAS attack would have significant psychological and operational impact. Like the V-weapons in WWII, that psychological effect would require significant commitment of military resources, thereby reducing military effectiveness in other areas.

The proposed theoretical framework provides a canvas for assessing the intensity of the enemy threat, crafting a friendly response, and determining the needed level of air control. In

WWII, excellent Allied intelligence allowed comprehensive planning, that included both OCA and DCA efforts, before the first V-weapon attack. Once the attacks occurred, the Allies modified their plan. The framework suggests the same course of action to counter adversary drones: conduct continuous intelligence, include UAS in the OCA targeting plan, and develop DCA systems capable of shielding US interests from all classifications of adversary drones.

These findings leave the United States with two primary courses of action. The United States can either change its concept of air superiority or commit the necessary resources to ensure sixty years of immunity from aerial attack continues. This is not an easy decision. The view from the cockpit of an F-15C is clear: choose air superiority, even near air supremacy, in all cases. However, a cyber-warrior, a space officer, an Army Ranger, or a naval surface warfare expert would likely argue for their domain. The final decision is likely to be a negotiated compromise. Ideally, this research positively informs the negotiators.

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